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NOTE:

This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Science 11. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

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OBJECTIVES OF

SECONDARY SCHOOL SCIENCE

FOR ALBERTA

The learning of science, as an area of human endeavor, should provide the student with a scientific literacy which enables him to assume an active and useful role as a citizen in a democratic society. It may be assumed that this literacy is best achieved by considering the individual needs of students and through independent study and learning.

Specifically, the following objectives must be achieved in the Secondary School Science:

1. To promote an understanding of the role that science has had in the development of societies:

   a) history and philosophy of science as part of human history and philosophy

   b) interaction of science and technology

   c) effect of science on health, population growth and distribution, development of resources, communication and transportation, etc.

2. To promote an awareness of the humanistic implications of science:

   a) moral and ethical problems in the use and misuse of science

   b) science for leisure-time activities

3. To develop a critical understanding of some current social problems which have a significant scientific component in terms of their cause and/or their solution. The students might study such issues as:

   a) depletion of natural resources

   b) pollution of water and air

   c) over-population

   d) improper use of chemicals

   e) science for the consumer

4. To promote understanding of and development of skill in the methods used by scientists:

   a) processes in scientific inquiry such as observing, hypothesizing, classifying, experimenting and interpreting data

   b) intellectual abilities such as intuition, rational thinking, creativity, and critical thinking

   c) skills such as manipulation of materials, communication, solving problems in groups, and leadership

5. To promote assimilation of scientific knowledge:

   a) emphasis on fundamental ideas

   b) relevance of scientific knowledge through inclusion of practical applications

   c) application of mathematics in science

   d) inter-relationships between the sciences

   e) open-endedness of science and the tentativeness of scientific knowledge

6. To develop attitudes, interests, values, appreciations, and adjustments similar to those exhibited by scientists at work.

7. To contribute to the development of vocational knowledge and skill:

   a) science as a vocation

   b) science as background to technical, professional and other vocations

THE SCIENCE 11 PROGRAM

INTRODUCTORY STATEMENT

Science 11, as a program, should continue to emphasize skills, concepts, attitudes, humanistic and social implications of science which have been developed for the elementary and junior high school grades.

In this course, content is significant only to the degree that it provides for the realization of other objectives of the course. Student interest should be a significant criterion in the selection of learning experiences.

MAJOR OBJECTIVES OF SCIENCE 11

1. To enhance the student's self-image and develop a positive attitude toward science.
   The student should: a) pursue areas of personal interest
   b) participate in activities in which he/she can experience success.

2. To develop a critical understanding of some current social problems which have a significant scientific component in terms of their cause and/or their solution. The students might study issues such as:

   a) depletion of natural resources
   b) pollution of water and air
   c) over population
   d) improper use of chemicals
   e) science for the consumer

3. To help students appreciate the scope of science. That is, the student should:

   a) recognize that science is a basic part of modern living
   b) recognize that science involves both inquiry processes and conceptual patterns
   c) recognize the interaction of science, the arts and the humanities
   d) recognize that the achievements of science and technology, properly used, are basic to the advancement of human welfare

RATIONALE FOR THE SCIENCE 11 PROGRAM

Student involvement in Science 11 should lead to successful experiences in learning and studying in various fields of science. During this course, it is hoped that students, as a result of their successful experiences,

will develop an attitude which allows them to realize the affective change on their lives which science brings about.

It is understood that the students taking Science 11 will have, in relation to science, a wide range of attitudes, interests, abilities, backgrounds, experiences, and knowledge. In order to assist teachers of these students in selecting relevant materials for their students a wide range of resources for classroom use has been identified. These resources, however, are not meant to be restrictive and teachers should feel free to supplement them.

RECOMMENDED RESOURCE MATERIALS

1. Class activity units*

2. Student projects*

3. a) *Ideas and Investigations in Science - Biology*, Wong and Dolmatz** Prentice-Hall

This text contains five Biology ideas

Idea 1: Inquiry
Idea 2: Evolution
Idea 3: Genetics
Idea 4: Homeostasis
Idea 5: Ecology

b) *Ideas and Investigations in Science - Physical Science*, Dolmatz and Wong Prentice-Hall

This text contains five Physical Science ideas

Idea 1: Predicting
Idea 2: Matter
Idea 3: Energy
Idea 4: Interaction
Idea 5: Technology

* For a sample activity unit and student projects, refer to this Curriculum Guide, pages 5 & 12. For a more extensive listing of activity units and student projects (with references) refer to the special School Book Branch publication entitled *Science Activity Units and Projects*. (Teacher reference only.)

** NOTE- Individual Ideas in both Biological and Physical Science are available from the School Book Branch in the soft cover format.

In order to satisfy the needs of the majority of students, a wide range of activities and resource materials has been identified. During the course of the year, it is suggested that students should be involved in:

1. activity units
2. individual or small group projects
3. class activities with the textual materials.

The relative amount of time spent on each of these areas is left to the discretion of the classroom teacher. It is anticipated each student will have the opportunity to try at least one individual project.

It is suggested that the textual materials provided be used to facilitate the development of certain process skills and understanding of some basic concepts that may be necessary for implementing activity units and projects. The activity units and projects selected would hopefully be current, topical, and relevant to the students. Each activity unit and project should provide students with opportunities to further develop their competence in:

1. seeking and evaluating information
2. experimenting
3. processing data
4. exploring implications of the project.

Sample activity units and a list of projects have been included in the School Book Branch publication entitled *Science Activity Units and Projects*. It is not intended that these be prescriptive but rather should serve as a guide for each teacher to establish similar activities and projects.

SCIENCE 11 ACTIVITY UNITS AND PROJECTS

The incorporation of activity units and student projects in the Science 11 program is seen as an acceptable approach in providing for the individual needs and various capabilities of the student.

The "Activity Unit" is designed to involve entire classes in investigating areas of science which are relevant to them and allows for maximum involvement of each student relative to his/her capabilities, background, and experience.

The "Project" is identified as a means of involving an individual student or small group of students in investigating topics in science which interest them at a particular time.

The activity unit and projects included in this Curriculum Guide are not intended to restrict or limit teachers in their endeavors to produce an effective science program for their students. Teachers may find these materials acceptable:

1. as they are presented
2. as outlines they can revise to suit their purposes
3. as guides in developing their own activity units and student project lists.

The School Book Branch publication entitled, *Science Activity Units and Projects* contains 5 activity units, 8 earth science project topics, 31 chemistry project topics, 26 physics project topics, and 4 biology project topics as well as a list of references for each.

SAMPLE ACTIVITY UNIT
(Carried out in Edmonton)

WATER POLLUTION

A water pollution study using river or stream water can be extremely enlightening with regard to learning something of the effects of man on his environment as well as learning numerous investigative procedures. This unit was designed mainly for the study of water samples taken from different points along the Saskatchewan River as it flows through Edmonton, but could also be used in numerous ways where water samples can be compared. Other adaptations of this activity unit could be carried out using various local sources of water samples such as streams, rivers, ponds, lakes, or wells. Comparative studies could also be carried out between two or more local sources or between water samples from one source, e.g., different depths of a well, different depths as well as different areas of a pond, stream, lake, or river. Samples could be taken at different times of day and/or year. See "Extension of Study" on page 10.

The objectives for this activity are:

1. To make students aware of the requirements for simple life (e.g., protozoa, algae)

2. To make students aware of different effects of various mineral ions on simple life.

3. To make students aware of different investigative procedures

4. To make students aware of the necessity of advance planning for procedures

5. To raise numerous questions as to possible sources of pollutants, possible experiments to test pollution, possible methods of decreasing pollution, as well as methods of preventing further pollution.

INTRODUCTION OF TOPIC

1. Some students expressed their concern about pollutants as a result of information in the news media.

2. Discussions followed on approaches to the problem of determining any existence of water pollution. A phone call to the city water department indicated that as a major city, Edmonton is still in the enviable position of using less water than the amount which flows through it.

3. Several points along the river as it flows through Edmonton were agreed upon for sample-collecting points as follows:

a) High Level Bridge area (before purification)
b) Dawson Bridge
c) Capilano Freeway Bridge
d) Beverly Bridge
e) immediately below the chemical plants

REFERENCES

Numerous references were used during the development of various phases of the studies to follow. The first five listed are the main ones, the others can be very useful but any of numerous biological or chemical resource books could give any of the required information for the experiments. The following references are only listed as a guide. Prices given are approximate.

1. Ward's Culture Leaflets (free, one set to a school)
   Ward's Natural Science Establishment Inc.
   Box 1712
   Rochester, N.Y. 14603

2. Turtox Service Leaflets (free, one set to a school)
   General Biological Supply House
   8200 South Hayne Avenue
   Chicago 20, Illinois

3. Morholt, Evelyn et al. — *A Sourcebook for the Biological Sciences*
   Harcourt, Brace, Jovanovich
   (available in Canada through Longman)
   1966. $12.05

4. Lutz, Welch, Galtsoff and Needham — *Culture Methods for Invertebrate Animals*
   Dover Publications Inc.
   (available in Canada through General Pub.)
   1937. $4.35

5. Abramoff, Peter and Robert Thompson — *Investigations of Cells and Organisms: A Laboratory Study in Biology*
   Prentice-Hall
   1967. $4.25

6. Lawson, Chester A. et al. — *Laboratory and Field Studies in Biology*
   Holt, Rinehart and Winston
   1960. $3.00

7. Smallwood, William L. and Edna R. Green — *Laboratory Investigations in Biology*
   Silver, Burdett and Co.
   (available in Canada through W. J. Gage Co.)
   1968.

8. Otto, Towle and Crider — *Biology Investigations*
   Holt, Rinehart and Winston

9. Besler, Tolman and Hocking — *Laboratory Exercises for Elements of Biology* (Biology 30 lab manual) McGraw-Hill

ADDITIONAL RECENT REFERENCES

10. Garten, W.A. — *Environmental Pollution* D. C. Heath Canada Ltd., Suite 1408, 100 Adelaide Street W., Toronto 110, Ontario

11. Horwood, R.H. — *Environmental Pollution* Macmillan of Canada Ltd., 70 Bond Street, Toronto 2, Ontario

12. Lamotte Chemical Co. (for catalogue) Water Pollution Detection Outfits, Chestertown, Maryland 21620

13. Hach Chemical Co. (for catalogue), Box 509, Ames, Iowa 50010

14. B.S.C.S. Green Version, High School Biology

15. Foth, Henry D. — *A Study of Soil Science* LaMotte Chemical Products Company Chestertown, Maryland 21620 (.50)

16. Renn, Charles E. — *A Study of Water Quality* LaMotte Chemical Products Company (.50)

17. Renn, Charles E. — *Our Environment Battles Water Pollution* LaMotte Chemical Products Company (.50)

18. Amos, William H. — *Limnology, An Introduction to the Fresh Water Environment* LaMotte Chemical Products Company (.50)

19. Elliott, Jeff — *Water Pollution and You* The Canada Water Act, Canadian High News 62 Shaftsbury Avenue, Toronto 230, Ontario (.50)

20. *Science Affairs* (Vol. 4, No. 3, September, 1970) Special Issue, Pesticides Youth Science Foundation, 151 Slater Street, Suite 302, Ottawa 4, Ontario

AUDIO-VISUAL LIST

1. *The Dirty Sky* - MF 37 - Video Tape (Provincial Dubbing Centre)

2. *The First Mile Up* - MF 57 - Video Tape (Provincial Dubbing Centre)

3. *The Soil and Life* - MF 10D - Video Tape (Provincial Dubbing Centre)

4. *The Tidal Zone* - MF 22D - Video Tape (Provincial Dubbing Centre)

5. *Water and Life* - MF 35 - Video Tape (Provincial Dubbing Centre)

OTHER FREE PUBLICATIONS AVAILABLE

1. *Alberta Pollution Control* - Department of the Environment, Edmonton

2. *Within Our Borders*, February, 1970 - Department of the Environment, Edmonton

3. *Air Pollution Primer* - Canada T.B. Association

PROCEDURES OF THE STUDY

The class is divided into five fairly even and competitive groups so that each group can do numerous experimental studies on a water sample. All groups will carry out common experiments on their particular water samples. The results from all groups could then be tabulated in summary tables for each experimental procedure. The summaries for each procedure on the entire set of samples could then be studied for any indication of possible changes in the Saskatchewan River water as it flows through Edmonton.

THE EXPERIMENTAL STUDIES

The following procedures of testing the river water samples were outlined after the groups discussed normal properties of river water and normal life in it. One class period was devoted to outlining some normal life cycles of organisms which can be found in rivers or streams.

1. Measurement of Plant Growth

a) Carefully chosen geranium slips (coleus could also be used) of equal size are started in pairs by each group. After potting, one is watered with distilled water, the second is watered with the group's river water sample. Each potted plant is watered at the same time with equal volumes of water and kept in a common environment. Growth and conditions of plants are measured and closely observed over the duration of the project.

b) Bean seeds (other seeds could also be used) are germinated and potted in pairs by each group. One is watered with distilled water, the other with the group's river water sample. The plants are kept in a common growing environment and closely observed for growth and condition.

c) Water plants (e.g. Elodea, water sprite, etc.) are taken in pairs by each group. One is placed in a (battery) jar to be compared for growth and condition with a second placed in an equal volume of their river water sample in another (battery) jar. Carbon dioxide is bubbled into each jar daily for an equal period of time to maintain growing conditions. Guppies may be used to supply necessary CO_2, however, the guppies may not survive the river water sample. If such is the case, snails could be used.

2. Algae Growth (references 1, 2, 3 and 5)

Some strands of oedogonium are placed in a sample of river water and compared with strands in established as well as vegetatively growing oedogonium. Adverse growth conditions induce sexual process or sporulation in most algae. Good growing conditions aid in maintaining a high rate of vegetative cell division. Other algae types could also be used.

3. Growth of Euglena (references 1, 2, 3 and 4)

Euglena culture media is prepared in pairs by each group, one using distilled water, wheat and timothy hay, a second using an equal volume of river water, wheat and timothy hay. After one week in a dark cupboard, each is inoculated with equal amounts of an established Euglena culture and placed in a part of the room which receives a rather continuous source of light. The newly inoculated cultures are then observed periodically (twice per week) for the duration of the project, both macroscopically and microscopically for any comparisons. Comparative counts can be made using reference 4, p. 53.

4. Reactions of Euglena to Concentrated River Water Samples

A portion of the river water sample used by the group is concentrated five-fold by evaporation. A few drops of this concentrate are added to a small drop of an established Euglena culture on a depression slide and observed comparatively under a microscope with an Euglena placed on a second depression slide without river water sample. Attempts are made to record time intervals before the Euglena stop moving if such is the case. This procedure is repeated several times as necessary.

5. Growth of Mixed Ciliates (e.g., Paramecia) (references 1, 2, 3 and 4)

Each group prepared two bowls of culture media for growing mixed ciliates (any reference above). One contained distilled water while the second had an equal volume of the group's river water sample. Each culture medium was subsequently inoculated with an equal volume of an established mixed protozoan culture. The types of ciliates in the inoculum were carefully observed and recorded. The newly inoculated cultures were observed periodically and compared for growth over the duration of the project. Density counts for growth determination were attempted by simply estimating the number of ciliates in any one field and tabulating these counts for each culture.

6. Reaction of Ciliates to Concentrated River Water Samples

The river water sample used by the group was concentrated five-fold by evaporation (use sample prepared in 4 above). The procedure in 4 was also repeated except that the mixed protozoan cultures were used.

7. Effects on Planaria (references 1, 2, 3 and 4)

When planaria are in ion-containing water or water in which organic contaminants are in a fairly high concentration, they will decompose. Each group maintained four planaria in a battery jar in water from which they were collected (Lake Wabamum). The planaria were individually exposed to the group's river water sample for different lengths of time. If the planaria decomposed, the time interval before they began decomposition was recorded.

8. Qualitative Chemical Analysis for Mineral Ions (reference 9)

Other reference sources are available for numerous qualitative tests for mineral ions. Each group carried out tests for different inorganic ions on their concentrated samples. A summary table of results is prepared from the results of all groups. Comparisons are made, the differences and possible reasons for differences are discussed. When an inorganic ion is observed as a possible Edmonton contaminant, the samples are rechecked for the particular ion by the different groups. The preparation of the required reagents can be done in most schools in association with the Biology 30 classes. In some cases, it may be necessary to concentrate the water samples to a greater degree.

9. Evaporation

Equal samples from each group were eventually evaporated completely to observe or measure the amount of deposit remaining. This procedure could use analytical scales if such are available to determine the weights of remaining residues.

10. Other Associated Studies

Numerous other studies or improvisations could add to the project, e.g.,
types of bacteria present (reference 8)
coliform bacterial counts (reference 3 and 8)

11. Associated Field Trips

Water purification plant
Sewage treatment

12. Extension of Study

Use can be made of references 10, 11, 12 and 13 to develop your own comparative water pollution studies on any samples your students might wish to use with regard to determining the presence of different kinds of chemical pollutants.

SUMMARY

After all experiments are completed by all groups, the data from each experiment is summarized on a common table by all groups. The tables are closely studied and the results critically analyzed on the basis of water samples and experiments. The question of Edmonton's effect on the Saskatchewan River is frequently raised. There are numerous opportunities during these discussions to direct any subsequent studies to any one of the following topics:

population effects
evolution
ecology and conservation.

NOTE: In carrying out such a project, it is absolutely imperative that students have and understand the overall process of the project. This can be achieved by direct student involvement in its planning and having daily plans of procedure for the duration of the project. During lulls in the experiments, articles from magazines, newspapers or other sources can be discussed. Government-produced publications can also be used during these times.

SAMPLE PROJECT TOPICS

A. EARTH SCIENCE PROJECTS

Topic	Explanation	Reference
Models of the earth's structure	Materials such as plywood, balsa wood, papier-maché, etc. are used to construct such things as reefs, faults, relief maps, etc.	#1 and #2
Construction of a simple seismograph	Students produce a simple device to measure shock waves.	#3 Nov. 15/68 Oct. 25/68

REFERENCES

1. Pond, G.G. — *Science Materials: Preparation and Exhibition for the Classroom* W. C. Brown, Dubuque, Iowa or Burns & MacEachern, Don Mills, Ontario

2. *Science World* Scholastic Publications Richmond Hill, Ontario

B. CHEMISTRY PROJECTS

Topic	Explanation	Reference
Purification of water	An exercise setting up a multiple still to remove impurities, and making diagrams of models of city water supply system, chlorination, etc. A field trip would be valuable in dealing with this topic.	#1 and #2
The manufacturing of and coloring of glass	Glass is made by melting silicon dioxide, sodium carbonate and lead oxide in a crucible. Various compounds are used to color the glass.	#2

REFERENCES

1. Hogg, John C. et al. — *Basic Science for Secondary Schools* D. Van Nostrand Co. Ltd. Toronto, 1965

2. Westmeyer, Paul — *Successful Devices in Teaching Chemistry* J. Weston Walch Portland, Maine, 1959

C. PHYSICS PROJECTS

Topic	Explanation	Reference
Metric measure	Students use and build models to help understand the units of metric measure for length, area, and volume.	#1
Burglar alarm	Solar cell is placed in a concealed box.	#2

REFERENCES

1. *The Science Teacher*
   Vol. 35, No. 3, March, 1968

2. *50 Easy-to-Build Solid State Projects*
   Radio Shack Corp., Boston, Mass.

D. BIOLOGY PROJECTS

Topic	Explanation	Reference
Studying structure of heart valves and blood vessels	The study may be made comparative by the use of specimens collected by students as well as those from local abattoirs. Labelled drawings could be made.	#1 and #3
Examination and dissection of various organs including lungs, kidneys and stomach	Students may preserve, compare and contrast various organs from different sources. These may be preserved by various techniques for future use.	#2 and #3

REFERENCES

1. Miller, D.F. and G. W. Blaydes — *Methods and Materials for Teaching Biological Science*
   McGraw-Hill, 2nd edition, 1962.

2. Morholt, E. et al. — *A Sourcebook of the Biological Sciences*
   Harcourt, Brace and World

3. Otto, Towle and Crider — *Biology Investigations*
   Holt, Rinehart and Winston, 1965

REFERENCES, A-V MATERIALS AND EQUIPMENT

No references are listed here because adequate references are included in the recommended textual materials and in the School Book Branch publication entitled, *Science Activity Units and Projects.*

The teachers' guides for the 11S Biology and 11S Physical Science contain lists of equipment and materials necessary to carry out the investigations for each idea.

SAFETY IN SCIENCE

All students must develop sensible attitudes regarding safety precautions. Attitudes determine behavior and cannot be taught as abstractions but must be built from experiences. To teach such attitudes is an important responsibility of the school. It is through situations that fall within the range of the student's own experience that safety attitudes and behaviors can be established. Reinforcing simple explanations of what not to do, with reasons that students can understand, followed by active participation and application of these practices is necessary. The best guide is the use of common sense; the best way to handle accidents is to prevent them. Some of the main danger areas will include handling of: heat sources, animals and plants, chemicals, electrical devices and glassware. When there is any possibility of an explosion, goggles should be worn.

LIVING THINGS IN THE CLASSROOM

A science room equipped with plants and animals can become a laboratory for stimulating many investigations. When inquiry, observation, and experiments are encouraged, the giving of ready-made textbook answers is kept to a minimum. Students learn to connect cause and effect and find out why certain things happen. Plants and animals stimulate speculation among pupils and lead them to the use of the process skills in conducting investigations.

It is strongly recommended that no experiment using live animals should be attempted unless the animals have clean, comfortable quarters with adequate food and water and humane procedures are followed at all times. Such an experiment should have as a clearly defined objective, the teaching of some biological principle which cannot be taught effectively without animals. Teachers who wish to have plants and animals in the school will find the following leaflet useful.

The National Science Teachers' Association, *How to Care for Living Things in the Classroom,* Washington, D. C. 20036

EVALUATION IN SCIENCE 11

In Science 11, an evaluation program is essential to the teacher in determining the extent of student growth toward the attainment of the objectives. In the approach to Science 11, where content is necessary only to the extent that it develops skills and attitudes, a radical change in evaluation procedures is necessary.

The evaluation of skills and attitudes can be accomplished effectively through:

1. direct observation and interviews
2. anecdotal records
3. teacher prepared checklist
4. student prepared checklist for self evaluation
5. mutual agreement between student and teacher of the evaluation
6. as determined by the checklists.

The following checklist can be used as a guide for the teacher in preparing his/her own list of categories for the evaluation of the development of skills and attitudes.

	Observing	Classifying	Oral communication	Written communication	Predicting	Formulating hypotheses	Defining terms	Controlling variables	Interpreting data	Manipulating equipment	Performing experiments			
Mary Joyce														
Willy Nilly														
Peter Piper														

In conclusion we must direct greater concern to involving the pupil in the total evaluation process and de-emphasize the role of marking for the sake of the report card. The evaluation in this course should be such that the student, through exerting some effort, will meet with success.

SUGGESTIONS REGARDING A FIELD STUDIES PROGRAM

A major goal of science teaching is to provide an opportunity for students to experience inquiry, discovery and investigation of the natural phenomena about which he is studying. In this light, field studies assume a greater importance than before. There are obviously many difficulties in arranging for worthwhile educational experiences outside of the classroom but the benefits of a well-planned excursion usually outweigh the difficulties and frustration. In an attempt to reduce the difficulties and frustration the following guide is presented.

HOW TO PLAN A FIELD STUDY

A field study is justifiable when it is a planned learning experience conducted with clearly defined purposes closely related to classroom activities. A class is ready for a field study only after appropriate problems are defined and the probable sources of data located. Without such pre-planning a field study trip will result in random observations.

1. Preparing a Field Study Outline - A study outline is frequently used as a means for increasing the effectiveness of a field study. The study outlines should contain: a short description of the problem; the questions to be resolved; and the observations to be made. It should also identify what is to be accomplished and enumerate what responsibility the student has for each activity. It may suggest data to be assembled, processes to be observed or specimens to be collected. It may also include data charts for the convenience of recording observations. Maps of routes showing points for observations and diagrams of resource sites may be useful. A list of essential equipment, supplies and special instructions form a part of this outline.

2. Choosing a Resource Site - Selection of the resource site should be made in terms of specific criteria which might include such things as the following: the possibility of seeing a scientist or technician at work, the convenience of the site to the school, the chance to correlate science with other school subjects, and opportunities for students to make use of knowledge and skills in interpreting a wide range of conditions and phenomena.

3. Assigning Responsibilities to a Conductor - The teacher should determine in advance whether he must assume the responsibilities for preparing and serving as a conductor or if such a person will be provided at the resource site. The teacher should provide the conductor with an outline of what the class wishes to know, the questions that may be asked, and some idea of the background and maturity level of the students. It may be necessary to train some members of the class as conductors if none are provided at the site.

4. Making Arrangements for the Use of the Site - Certain mechanical details such as the following must be attended to: Should all students visit the site? How much supervision will be required? When is the best time of day or year to visit the site? How much time will the visit require? What points on the way to the site are of special interest? How should the class be organized?

5. Checking Details - Arrange permission and transportation well in advance of the trip. Send home permission forms, if needed, and check returns. Send a copy of the study outline to any adults who are to assist with the trip. (Don't forget the administrators.) Confirm with those in charge of the site at least three days before you visit, that you will be arriving on schedule.

   Student committees might well determine such things as: suitable dress, accessible equipment, behavior standards, safety rules, working out the itinerary on a map showing special points to be observed.

6. Following-up - Some specific purposes of the field follow-up might be:

   a) to obtain reports from the various committees on the data gathered so that information may be shared, interpreted, clarified or appraised.

   b) to organize and review the ideas and materials gained by oral or written reports, bulletin displays, demonstrations, worksheets, discussions, use of photographs, tests or identification of specimen materials obtained on the trip. Each student should have some responsibility in interpreting what he saw and explaining what it means.

7. Evaluating - The teacher will attempt to determine the degree to which his other purposes for taking the field study were met. Evidence might include having pupils complete a questionnaire, student-prepared booklets, and anything that might be collected to support the general objectives of Science 11. Problems that arose should be noted for revision of plans for future trips. Some attempt should also be made to determine the usefulness of the resource sites for future field studies.

Suggestions for Field Studies - a brief list to illustrate the kinds of field studies that may be undertaken.

- Agricultural experimentation centers - University Farm, Government agricultural stations, etc.
- Airports
- Wildlife sanctuaries and preserves
- College or University or Technical Institute science departments
- Computing science centers

- Power plants - water treatment plants - disposal facilities
- Natural features - river valley, small lake, large lake, woodlot, dams, etc.
- Museums
- Industrial and manufacturing plants

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CURRICULUM GUIDE

For Reference

NOT TO BE TAKEN FROM THIS ROOM
EXCEPT WITH LIBRARIAN'S PERMISSION